DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT
CORPS OF ENGINEERS
CONCORD, MASSACHUSETTS

WATER QUALITY CONTROL MANAGEMENT PROGRAM
ANNUAL REPORT
FISCAL YEAR 2000

JANUARY 2001

FOREWORD

While the New England office of the Corps was an independent division, regulations required us to submit an annual water quality report to the Chief of Engineers in Washington, D.C. When the New England office became a district under North Atlantic Division (NAD) in 1997 the annual reporting requirements changed. We prepare and send information to NAD that they use to prepare the required report to Washington. While we are no longer required by regulation to prepare an annual report in this format, we continue to do so because it meets our needs for recording and reporting what happened during the year.

This Fiscal Year 2000 Annual Water Quality Report of the New England District is a continuation of reports that began in 1978. Information contained herein updates that presented reports prepared through FY98. Duplication of previous information has been kept to a minimum.

Mr. Townsend Barker of the Water Management Section prepared this report and is available to provide additional information on areas of further interest (telephone: 978-318-8621).

NEW ENGLAND DISTRICT
WATER QUALITY CONTROL MANAGEMENT
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1. GENERAL BACKGROUND

NAE has completed 35 dams, 5 hurricane barriers, and 112 local protection projects within the New England area. Figure 1 shows locations of the dams. In addition, NAE has acquired flowage rights on more than 8,000 acres of flood-prone Massachusetts lands within the Charles River Natural Valley Storage area. All local protection projects, four dams, and three hurricane barriers have been turned over to local interests, and the remainder are operated and maintained by NAE. Most construction prior to 1955 was authorized for flood control purposes only; however, approval has been given for other uses at many of NAE's older reservoirs, due to development of new water resource needs in the basins. Most of the newer projects have been designed for more than flood control storage, e.g., recreation, conservation, and low flow augmentation; furthermore, Littleville and Colebrook River Lakes have significant water supply storage. Hydropower facilities have been constructed at seven sites on Corps-owned lands; however, these are designed, built, operated, and maintained by private interests not connected with the Corps.

Although water quality management is not a defined purpose at any project operated and maintained by NAE, the Corps has a long-standing, strong interest in water quality. Executive Order 11752, "Prevention, Control, and Abatement of Environmental Pollution at Federal Facilities," 19 December 1973, makes it a stated national policy that the Federal Government, in the design, construction, and operation of its facilities, shall provide leadership in the nationwide effort to protect and enhance the quality of our air, water, and land resources. Section 102b, of the Federal Water Pollution Control Act Amendments of 1972 places responsibility with EPA for determination of the need for, the value of, and the impact of storage for water quality control in reservoir projects constructed after 1972. Responsibility for water quality management at Corps projects, however, clearly rests with the Corps since it is an integral part of our water control management activities. To meet this responsibility, area-wide water quality management programs must be established, specific water quality objectives for each reservoir area-wide water quality management programs must be established, specific water quality objectives for each reservoir project developed, and procedures implemented to meet these objectives. To

NED RESERVOIR PROJECTS INCLUDED IN ITS
WATER QUALITY MANAGEMENT PROGRAM

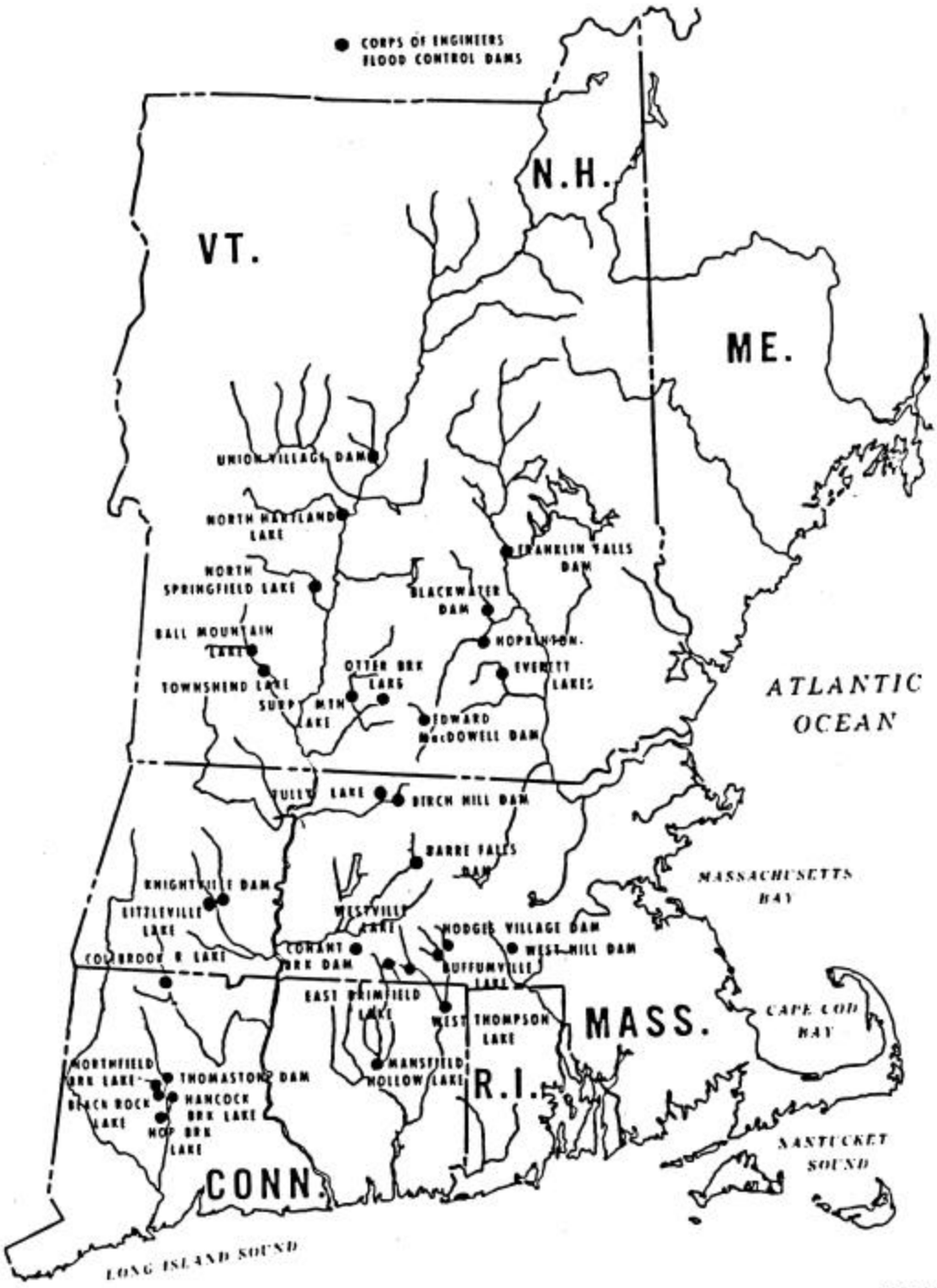

FIGURE 1

ensure success, continual collection and evaluation of water quality data and reporting of water quality management activities are necessary. The Annual Water Quality Reports, required of each Corps Division, are part of that program of evaluation and reporting.

NAE's reservoir water quality control management program has multiple goals. Its primary purpose is to protect public health and safety, but additional goals include meeting State water quality standards, maintaining water quality suitable for all project purposes, and understanding the effects of project operations on water quality. The Master Water Control Manual for each basin includes the goals and objectives for the water quality program.

This annual report is a summary of water quality conditions and activities during the year. In addition to meeting North Atlantic Division's reporting requirements, it is a valuable tool for reviewing the past year's program and charting the course for the following year. This report is not limited to activities under the Corps Reservoir Water Quality Operations and Maintenance Program, but includes other Corps water quality activities and concerns related to various studies, investigations, and designs.

2. SUMMARY

The FY00 (1 October 1999 through 30 September 2000) NAE reservoir water quality control management program was similar to that presented in the FY99 Annual Water Quality Report (AWQR). Total program size was equal to $314,000, an increase of 24 percent from the previous year. This large increase was due to specific studies requested and paid for by Operations Project Managers at Hop Brook, Northfield Brook, and North Hartland Lakes. No changes were made in the basic structure of NAE's classes I, II, and III water quality classification system (described in Appendix A). The water quality team formed in 1982, with representatives from Engineering/Planning and Construction/ Operations Divisions continued setting direction for the overall water quality program and coordinated all its elements.

FY00 had a cooler and wetter than normal spring and summer, but with no real flooding. The dry conditions persisting in New England during FY99 were slowly replaced with wet conditions beginning with tropical storm Floyd in September. Most New England watersheds experienced near average monthly rainfall with the late spring and summer months having greater than normal amounts. June and July were notably wet with total rainfall in some southern New England watersheds measuring up to two or three times the average levels. Algal blooms were

generally less of a problem at NAE projects, but it's uncertain that was due to the weather, and beach closures, which are generally related to rainfall were up; otherwise, it was a fairly typical year for water quality conditions.

Water quality was good to excellent at most projects with concerns generally caused by external phenomena, such as upstream nonpoint source discharges or acid precipitation. By "good water quality" we mean the water generally met or exceeded State standards, and was suitable for its intended uses, which at most projects was recreation, and fish and wildlife habitat. Table 1 contains current NAE classifications of existing reservoir projects. State water quality classifications are listed in Appendix B.

Activities performed by NAE in FY00 under the Reservoir Water Quality Operation and Maintenance Program included

- Potable water and bathing beach water quality monitoring.

- Baseline monitoring of class III and I projects with conservation pools.

- Continuation of the study of the relationship between rainfall and elevated bacteria counts at beaches.

- Completion of reports on the Conant Brook Dam and Hancock Brook, Black Rock, and Mansfield Hollow Lakes priority pollutant scans.

- Study of algae and fisheries at North Hartland Lake.

- Lakewatch Studies at Hop Brook and Northfield Brook Lakes.

- Review of data relating to an old landfill near Mansfield Hollow Lake and its possible effects on water quality in the lake.

Water quality activities performed in FY00 as part of other studies, investigations, and designs included

- Water quality monitoring at the Town Brook tunnel.

- Completion of draft reports on water quality problems at Parker Pond in Massachusetts and Turner Reservoir in Rhode Island.

TABLE 1
NAE RESERVOIR PROJECT CLASSIFICATION
1 JANUARY 2001

Class III	Class II	Class I
Five projects with definite water quality problems.	Six projects with minor water quality problems.	Seventeen projects with no significant water quality problems.
Three Lakes	Five Lakes	Thirteen Lakes
Hop Brook, CT	North Hartland, VT	Ball Mountain
Northfield Brook, CT	Hopkinton, NH	North Springfield, VT
West Thompson, CT	Buffumville, MA	Townshend, VT
	East Brimfield, MA	Edward MacDowell, NH
	Tully, MA	Everett, NH
		Otter Brook, NH
		Surry Mountain, NY
		Littleville, MA
		Westville, MA
		Black Rock, CT
		Colebrook River, CT
		Hancock Brook, CT
		Mansfield Hollow, CT
Two Dry-Bed Reservoirs	One Dry-Bed Reservoir	Seven Dry-Bed Reservoirs
Union Village, VT	Thomaston, CT	Blackwater, NH
Birch Hill, MA		Franklin Falls, NH
		Barre Falls, MA
		Conant Brook, MA
		Hodges Village, MA
		Knightville, MA
		West Hill, MA

- Continued study of cleanup of the Muddy River in Boston, Massachusetts.

- Continued salt marsh restoration activities from study to construction.

- Continuation of long-term monitoring at Superfund cleanup sites.

Water quality personnel at NAE continued coordinating with Federal, State, and local officials regarding mutual water quality concerns. In an effort to promote information exchange, copies of this report are being provided to relevant State and Federal agencies and interested private parties.

Appendix C contains a summary of reservoir water quality control management reports.

3. RESERVOIR WATER QUALITY OPERATION AND MAINTENANCE PROGRAM

a. Water Quality Team. NAE's water quality team (WQT), established in 1982 with members from Engineering and Operations Directorates, continued functioning smoothly in 2000. Regular meetings throughout the winter and early spring enabled the team to plan the 2000 reservoir water quality program. Additional meetings during the summer and fall as needed coordinated the ongoing program. Mr. Bruce Williams of Technical Services Branch represented Construction/Operations, Mr. William Hubbard, Chief Environmental Resources Section represented Planning, and Mr. Townsend Barker of the Geotechnical and Water Management Branch continued as Engineering's representative and chaired the team. Table 2 contains a summary of experience levels of members of the water quality team, and the principals involved in carrying out the water quality programs.

b. Potable Water Quality Monitoring. NAE monitors 53 drinking water wells at 25 reservoir projects on a regular basis. In accordance with requirements of the Environmental Protection Agency's "Total Coliform Rule," sampling frequency is based on expected monthly usage as predicated from past records. Biweekly, monthly, or quarterly samplings are called for during the recreation season. Drinking fountains at NAE's recreation areas are open from approximately the third Saturday in May to the weekend after Labor Day. Monitoring could vary on a monthly basis according to the actual number of visitors expected. However, for simplicity's sake, sampling at each project, during the recreation period, was set according to the expected maximum monthly attendance for the year. During the remainder of the year, wells kept open for project personnel are monitored quarterly. Monitoring for

TABLE 2
WATER QUALITY STAFF

EMPLOYEE	SECTION	POSITION TITLE	GRADE	YEARS OF EXPERIENCE	AREAS OF EXPERTISE
Barker, T.*	Water Management	Hydraulic Engineer	GS-12	26	Water chemistry, computer modeling, environmental engineering, hydrologic engineering
Geib, M.	Water Management	H&H Team Leader	GS-13	24	Technical review, hydrologic engineering, computer modeling
Hubbard, W.*	Environmental Resources	Environmental Resource Specialist	GS-13	22	Aquatic ecology, benthic interactions, habitat restoration, environmental regulations
Levitt, K.	Environmental Resources	Biologist	GS-11	17	Fisheries biology, limnology, aquatic microbiology
McNally, N.*	Water Management	Physical Science Technician	GS-9	14	Sample collection, HTW
Miller, K.	Water Management	Chemist	GS-11	10	Chemistry, sample collection
Trinchero, P.	Environmental Resources	Biologist	GS-11	28	Fisheries biology, limnology, aquatic microbiology, ecology
Williams, B.*	Operations Technical Support	Park Manager	GS-12	21	Wildlife biology, wetlands, environmental compliance and restoration
Wood, D.	Water Management	Hydraulic Engineer	GS-12	26	Environmental engineering, computer modeling, hydrologic engineering

other parameters is performed as required by the States where the wells are located. All systems are maintained by licensed VSSO's – very small system operators. Table 3 contains a summary of the projects, by state, where NAE monitors potable water quality.

NAE samples the wells, but bacteria analyses are performed by contract laboratories. Laboratories used included Alpha Analytical Labs in Westborough, Spectrum Analytical in Agawam, and Microbac in Clinton for Massachusetts samples; Biological Services in Keene and Eastern Analytical in Concord for New Hampshire; Aquacheck Water Testing Laboratory, in Weathersfield for Vermont; and Northeast Laboratories Inc. in Berlin for Connecticut samples.

Drinking water standards require less than one total coliform bacterium per 100 ml. Wells showing possible contamination are closed, chlorinated, flushed, and retested. If retesting shows the well to be safe, it is reopened. However, wells may also be closed for other reasons, including excessive turbidity or noncoliform bacteria.

Wells at Birch Hill and Thomaston Dams and Edward MacDowell Lake tested positive for fecal coliforms once during FY00. None tested positive for E. coli., and retesting after chlorination showed safe conditions. Total coliforms are commonly found after work has been performed on the wells or water lines and the system has not been thoroughly chlorinated and cleaned.

The well at North Springfield Lake's Stoughton Pond recreation area repeatedly tested positive for total coliforms in mid July and the beginning of August, although it never tested positive for E. coli. The problem at North Springfield Lake was finally resolved by studying the system and then disassembling and thoroughly cleaning the fountain. After repeated testing showed good results, the well was reopened in early August.

In mid August, the well at Surry Mountain Lake's recreation area tested positive for total coliforms on a compliance sample. Repeat tests were also positive, and it was ten days before it had an acceptable result. Then as Labor Day weekend approached, another compliance sample tested positive. The fountain was closed for the final part of the recreation season, and the project contracted with a Water System Consultant to study the system and recommend changes. The project has removed and disposed of the old, steel, underground tank, prepared the site to receive new tanks, and started the rehab work on the small outbuilding that houses

TABLE 3

POTABLE WATER QUALITY MONITORING
AT NAE RESERVOIR PROJECTS

	Wells Monitored
Vermont	
Ball Mountain Lake	6
North Hartland Lake	1
North Springfield Lake	3
Townshend Lake	3
Union Village Dam	2
New Hampshire	
Blackwater Dam	1
Edward MacDowell Lake	1
Everett Lake	1
Hopkinton Lake	3
Otter Brook Lake	2
Surry Mountain Lake	2
Massachusetts	
Barre Falls Dam	2
Birch Hill Dam	1
Buffumville Lake	2
East Brimfield Lake	1
Knightville Dam	3
Littleville Lake	1
Tully Lake	2
West Hill Dam	4
Connecticut	
Colebrook River Lake	1
Hop Brook Lake	4
Mansfield Hollow Lake	1
Northfield Brook Lake	2
Thomaston Dam	1
West Thompson Lake	3

the well head. They anticipate having a new pressure tank and new polyethylene water storage tanks installed and the system inspected, tested, and operational before the park is opened on 19 May 2001.

c. Bathing Beach Water Quality Monitoring. Swimming areas at 13 NAE reservoirs were operated by the Corps in 2000. Table 4 contains a summary of projects, by State, where water quality for bathing is monitored by NAE.

Beaches maintained by NAE are monitored biweekly during the recreation period which runs from about the third weekend in May until Labor Day. Experience has shown that bacteria counts tend to rise after rainstorms. Consequently, in 1994, NAE began extra monitoring of selected projects following rainstorms, to develop a database for predicting how long beaches need to be closed. This was particularly important in Connecticut because the required *Enterococcus* test takes two days.

Based on results from the study of bacteria counts after rainstorms, we began administrative closures of beaches at Hop Brook and Northfield Brook Lakes in Connecticut in 1997. This is explained in more detail in paragraph 3e, but briefly, the beaches were closed when rainfall at the projects met certain conditions, without waiting for actual bacteria counts.

High bacteria counts normally occur at beaches only after rainstorms, and the wet spring and summer had a number of beach closings. The opening of the beach at Northfield Brook Lake in Connecticut was delayed because of findings of high bacteria counts in the initial samplings. However, by the beginning of June, all beaches were open. Beaches at Hop Brook, Northfield Brook and Surry Mountain Lakes were closed once each in June. In July, beaches at West Hill Dam and Hopkinton, Townshend, Hop Brook and Northfield Brook Lakes were again closed once. Most closings occurred in August. Hopkinton and Surry Mountain Lakes and West Hill Dam were closed once that month. Hop Brook Lake was also closed only once, but it lasted for more than a week; Union Village Dam was closed only once, but it lasted two weeks. Buffumville, Northfield Brook, and Townshend Lakes were each closed twice in August.

Beach monitoring in FY01 is expected to be the similar to that in FY00 with biweekly monitoring of all projects, supplemented with additional sampling following heavy rain.

TABLE 4

BATHING BEACH WATER QUALITY MONITORING
AT NAE RESERVOIR PROJECTS

Vermont	Locations Monitored
Ball Mountain Lake	1
North Hartland Lake	1
North Springfield Lake	1
Townshend Lake	1
Union Village Dam	1
New Hampshire	
Edward MacDowell Lake	1
Hopkinton Lake	1
Otter Brook Lake	1
Surry Mountain Lake	1
Massachusetts	
Buffumville Lake	1
West Hill Dam	1
Connecticut	
Hop Brook Lake	1
Northfield Brook Lake	1

d. Baseline Fixed Station Monitoring. In order to use resources efficiently, while meeting requirements to monitor water quality trends and changes at Corps projects, NAE splits its baseline water quality program into high and low level

monitoring. Briefly, the difference between these two levels is in the statistical certainty of results. High level baseline monitoring involves a higher level of statistical certainty, and a larger number of samples than low level monitoring. The NAE Annual Water Quality Report for 1990 contained a detailed explanation of the statistical basis used for selecting sampling frequency for water quality monitoring at NAE projects.

Low level baseline monitoring was performed in 2000 at the class I projects with conservation pools. Baseline data collection was last performed at these projects in 1997. Class I projects are those with generally high water quality with no known water quality problems. Only minimal data requirements exist for these projects in order to check for changes and monitor trends.

Class I projects with permanent pools now include a total of thirteen – Ball Mountain, Black Rock, Colebrook River, Edward MacDowell, Everett, Hancock Brook, Littleville, Mansfield Hollow, North Springfield, Otter Brook, Surry Mountain, Townshend, and Westville Lakes. The number of class I projects with pools has become too large to sample all of them in one year. Consequently, the projects have been divided geographically to facilitate sampling. In FY00 the Massachusetts and Connecticut projects were sampled; these include Black Rock, Colebrook River, Hancock Brook, Littleville, Mansfield Hollow, and Westville Lakes. The remaining seven projects are scheduled for sampling in FY01. At each project, 2 to 4 stations were sampled three times from April through September. Parameters analyzed included field parameters (DO, pH, temperature, conductivity, turbidity), nutrients (ammonia, nitrite plus nitrate, total phosphorus), indicator organisms for sanitary contamination, and trace metals. Starting in FY00, chlorophyll *a* analyses became part of the baseline-sampling program as a means of assessing lake trophic condition.

High level baseline monitoring was performed in 2000 at the class III projects with conservation pools. Class III projects are those with continuing water quality problems, and receive more frequent and intensive sampling than class I or II projects. In 2000 there were three class III reservoir projects with conservation pools: Hop Brook, Northfield Brook, and West Thompson Lake, all in Connecticut. The concerns at these projects are bacteria levels and algae. Baseline data was last collected at these projects in 1998. Inflow, lake and discharge stations were sampled six times from April through October. Parameters analyzed included field parameters (DO, pH, temperature, conductivity, turbidity), nutrients (ammonia, nitrite plus nitrate, total and ortho-phosphorus), fecal coliform bacteria, hardness, and mercury. Starting in FY00, chlorophyll *a* analyses were included in baseline sampling

as a means of assessing lake trophic condition. The number of stations were 2 at Northfield Brook, 4 at Hop Brook, and 5 at West Thompson Lake

Data collected in 2000 at these projects will be used to update their respective water quality reports. This work is scheduled for later in fiscal year 2001.

e. Beach-Rainfall Study. In 2000 NAE continued its study of the relationship between rainfall events and high bacteria counts at beaches, to further develop administrative closure protocols. This study began in 1994 because NAE was concerned its beach monitoring program was not providing a good means to determine when beaches should be open or closed. Typically, beaches are closed after a high bacteria count and reopened when counts are below the standard; however, because of delays in getting results, beaches may be opened when they should have been closed, and closed after the danger has passed. High bacteria counts are usually related to rainfall, but NAE lacks the resources to sample all beaches every time it rains. Consequently, NAE began a study to determine when beaches should be opened and closed based on rainfall at four of NAE's most popular projects -- Hop Brook and Northfield Brook Lakes in Connecticut, Townshend Lake in Vermont, and Surry Mountain Lake in New Hampshire. At these projects, samples were collected for several days after heavy rainfall events during the recreation season.

Administrative closure protocols were developed and implemented at Hop Brook and Northfield Brook Lakes, but additional data were required to develop a useable protocol at Townshend Lake. Otter Brook Lake was dropped from the program because the relationship between rainfall and beach bacteria appeared to be too complex to allow development of an administrative closure plan. This was not a major setback, however, because beach closures at Otter Brook are much less frequent than at Hop Brook or Northfield Brook Lakes.

In 1998 the beach at West Hill Dam in Massachusetts was added to take the place of Otter Brook Lake in this study. Hop Brook Lake was dropped because it did not appear that further study would refine the administrative closure protocol further, and Buffumville Lake in Massachusetts took its place. Northfield Brook Lake was retained because changes in its watershed due to sewering an area with problem septic systems meant that the beach closure protocol might need to be revised to be less strict.

The near complete lack of rainfall during the swimming season meant that very little information was collected in FY99. However, the wet spring and summer of FY00 provided additional data, especially at Townshend Lake. This study will likely continue during the 2001 recreation season.

f. EPA Priority Pollutant Scans.

(1) General. Contaminants are an area of great concern to the Corps nationwide. In response to ETL 1110-2-281 "Reservoir Contaminants," many Corps Divisions have tested for the full range of EPA priority pollutants at all their projects. NAE began performing priority pollutant scans in 1987, when the NAE Lab achieved the ability to analyze organic compounds on the priority pollutant list. Hopkinton Lake and Birch Hill Dam were the initial projects studied. NAE intends to perform similar scans at all projects eventually. During FY00, priority pollutant scan reports were completed for Black Rock, Hancock Brook, and Mansfield Hollow Lakes and Conant Brook Dam. Table 5 gives a summary of the status of priority pollutant scans at NAE projects.

(2) Hancock Brook and Black Rock Lakes. In FY00 the WQT completed reports on priority pollutant scans at Hancock Brook and Black Rock Lakes, two small NAE-operated flood control project in Connecticut's Naugatuck River basin. Findings are reported in "Hancock Brook and Black Rock Lakes, Pollutant Scan," March 2000. Samples were collected on October 4, 1996, and analyzed for metals, PCBs, pesticides, volatile and semi- volatile organic compounds, dioxins and furans, and TOC. Overall levels of EPA priority pollutants in sediments at these projects were low and not a threat to humans or aquatic organisms. Levels of some compounds were high enough to possibly affect sensitive benthic organisms, but these effects should be minor. No substances were in high enough concentrations to interfere with uses of the projects and their waters; however, levels of semi-volatile organics at Black Rock Lake were higher than is normally found at NAE projects. To check that this was not part of a larger problem, a sample was collected for additional analyses in September 2000; preliminary analyses of these results do not show a concern.

(3) Conant Brook Dam. The WQT completed a report on a priority pollutant scan report at Conant Brook Dam in Massachusetts, "Conant Brook Dam, Pollutant Scan," April 2000. Overall levels of EPA priority pollutants at this project were low and indicative of natural background conditions. Although some contaminants were found in concentrations high enough to have possible effects on sensitive benthic organisms, these effects would be minor, and no substances were

TABLE 5

PRIORITY POLLUTANT SCANS
AT NAE RESERVOIR PROJECTS

Project	Report
Connecticut	
Black Rock Lake	Mar 2000
Colebrook River Lake	Sep 1997
Hancock Brook Lake	Mar 2000
Hop Brook Lake	Apr 1993
Mansfield Hollow Lake	Sep 2000
Northfield Brook Lake	Jul 1992
Thomaston Dam	Aug 1994
West Thompson Lake	Dec 1994
Massachusetts	
Barre Falls Dam	Jul 1995
Birch Hill Dam	Jul 1988
Buffumville Lake	Jan 1999
Conant Brook Dam	Apr 2000
Hodges Village Dam	Jan 1999
Knightville Dam	Sep 2000*
Littleville Lake	Sep 2000*
West Hill Dam	Apr 1999
New Hampshire	
Franklin Falls Dam	Nov 2000
Hopkinton Lake	Jun 1988
Otter Brook Lake	Feb 1993
Vermont	
Ball Mountain Lake	Jun 1998
North Hartland Lake	Jun 1998
North Springfield Lake	Jun 1998
Townshend Lake	Jun 1998

*Data collected, report being prepared.

in high enough concentrations to pose a risk to humans or interfere with uses of the project and its waters.

Four VOC's were detected, apparently the result of a spill or leak of a small amount of gasoline. While levels were low, below reportable concentrations, and not a concern, another sample was collected and analyzed for VOC's in September 2000 to confirm this was not part of a larger problem; results showed no detectable levels.

(4) Mansfield Hollow Lake. WMS completed a report on a priority pollutant scan at Mansfield Hollow Lake and results are given in "Mansfield Hollow Lake, Priority Pollutant Scan," September 2000. Results showed low to very low concentrations, indicative of expected background conditions. Levels of some contaminants were high enough to possibly affect sensitive benthic organisms, but these effects should be minor. No substances were in high enough concentrations to interfere with uses of the project or its waters.

(5) 2001 Activities. In FY01 reports are scheduled for completion on Franklin Falls and Knightville Dams and Littleville Lake. Data will likely be collected at additional projects including Everett and Westville Lakes.

g. North Hartland Lake Studies. North Hartland Lake is experiencing an increasingly heavy growth of rooted aquatic vegetation within the upper reaches of the lake, indications of developing algal bloom problems, and a lack of largemouth bass despite sufficient forage fish and breeding area. In FY00 NAE addressed these problems through a combination of watershed sampling and the Lakewatch program. The search for possible high phosphorus inflows in the watershed that might be responsible for the aquatic weed and algal problems was hampered in past years by quality control problems at the contract laboratories. In FY00, NAE began using the Vermont State Laboratory for phosphorus analysis. Their state-of-the-art equipment gives reliable results with an order of magnitude more accuracy.

Sampling of the Ottauquechee River upstream from the project boundaries did not find any especially high nutrient sources. Results from lake profiles showed that nutrient values are elevated but only approaching levels likely to cause accelerated eutrophication. Much rooted vegetation remains in George Perkins Marsh area at the upstream end of the lake, but none of the floating mats of blue green or blue-green algae seen in the previous couple of years were visible in FY00. It could be the cool, wet conditions experienced in the summer of 2000 or that something changed in the watershed.

At the upstream end of the project, before the river goes through the gorge and into North Hartland Lake, is Deweys Pond. The Ottauquechee River does not flow through the pond except during high flow events when the dike is overtopped, and the effects of water quality conditions in the pond on North Hartland Lake are

not clear. However, they may be important because phenomenal aquatic macrophyte growth was observed in the pond. A high nutrient source must be available to support these plants, but it is not clear what this source is or whether a significant amount of these nutrients make it into the lake. Additional sampling will be required to resolve that.

The condition of the lake's fishery was examined using gill netting, seining, and electrofishing. Initial results indicate similar conditions to those seen in the last sampling in the lake. The area upstream of the beach has a large white sucker population while the two bays on the east side of the George Perkins Marsh Area supported members of the bass family including blue gills and pumpkinseeds, but no young-of-the year bass. North Hartland appears to have the potential to support a largemouth bass fishery if a breeding population is established and if the proper management procedures are employed. The Deweys Pond area could provide a nursery for a largemouth bass population in the lake. A possible next step is to seek Vermont's approval to transport yearling bass from North Springfield Lake or Stoughton Pond to stock North Hartland Lake, and to follow the population.

h. Lakewatch at Hop Brook Lake. Water quality conditions at Hop Brook Lake have changed, possibly significantly, as evidenced by fewer reports of potentially toxic algal blooms and fewer beach closures over the last several years. As algae and other microorganisms form the very base of the food chain, this indicates a change in the lake's ecosystem. Lakewatch provides a picture of conditions at the top of the food chain through fisheries analyses, as well as water quality conditions in the lake. Combining lake water-quality profiles and nutrient analyses in a Lakewatch study with baseline data already scheduled for collection in the watershed in FY00, will provide a more complete view of the effects of the watershed dynamics on the lake. Fishery sampling in the lake in the late 1970's and early 1980's revealed a good warmwater fishery based on the chronically enriched condition of the lake. These nutrients supported a food web of forage fish and population of largemouth bass. Data also indicated stocked salmonids migrated from the lake into Welton Brook, one of the lake's main tributaries, during warm summer conditions to establish naturally breeding populations. A lack of relevant recent data combined with the continued high fishing pressure on the lake caused the Project Manager to request a Lakewatch study to determine the status of this fishery as an essential aid for any management decisions.

Results from the watershed and fishery portions of the study will be analyzed in FY01. However, indications of a possible return of nuisance algal blooms were found, and a recommendation was made to the Project Manager to consider expanding the wetland at the inflow to the lake to enhance its ability to remove nutrients.

i. Lakewatch at Northfield Brook Lake. The Project Manager was concerned that siltation and other problems were degrading the project's fishery and beach, but he was not sure how to address them. The State of Connecticut stocks the lake as a put-and-take trout fishery, but there was no data on the actual species composition in the lake or the condition of the warmwater fishery. Without data it was difficult to evaluate the problem much less possible solutions. In addition, attendance at Northfield Brook Lake's beach has been falling in recent years and the Project Manager wanted advice on improving the beach. Consequently he requested a Lakewatch study to look at ways to improve the project's fishery and beach.

The requested study performed water quality profiles in the lake, examined the fishery through electro-shocking, and examined the physical condition of the beach. Results from the fishery portions of the study will be analyzed in FY01, but a list of recommendations for improving the beach was given to the Project Manager in August. These recommendations include changes to the drainage and beach layout that will improve the appearance and water quality at the swimming area.

j. Mansfield Landfill. The Connecticut Department of Environmental Protection (CTDEP) is investigating the old Mansfield landfill. Located on the north side of the Fenton River, it is just off Corps Mansfield Hollow Lake property, but CTDEP has received reports that an underground leachate plume from the landfill may be moving into the Corps project area. The Town of Mansfield has been collecting data in the Fenton River and from four groundwater-monitoring wells, and a consultant's study showed a plume of low pH groundwater going under the Fenton River and into Corps property. They are concerned that the low pH may facilitate or lead to the leaching and mobilization of heavy metals. However, it would be an unusual hydrologic condition that would cause a groundwater plume to move under a river, and the CTDEP is not convinced that the monitoring wells are properly located to determine what is actually happening. Currently NAE is reviewing and sharing data with CTDEP. The Mansfield Hollow Lake priority pollutant scan did not show a problem with heavy metals, but sampling stations were not located to specifically look at the possible effects of the landfill. If CTDEP concludes that a contaminant plume is moving into Mansfield Hollow Lake, they may request Corps permission to install wells or cutoff walls on NAE property. As long as CTDEP continues to take the lead in this investigation, NAE will restrict its activities to coordination and review of data.

k. FY00 Reservoir Water Quality Concerns. NAE rated water quality at most of its reservoirs during FY00 as good to excellent, because it usually met State standards and was usable for its intended purposes. External phenomena including acid rain, urban runoff, wastewater treatment plant discharges, and natural

watershed conditions were primary causes of water quality concerns. Corps project operations do not adversely affect water quality at any NAE reservoirs.

Table 6, a summary of water quality concerns at NAE projects in FY00, shows many projects with high levels of metals, color, nutrients, turbidity, and bacteria; and low levels of pH and DO. However, some things need explaining lest this table presents an unrealistically bad impression of water quality conditions. What the table lists are water quality concerns – these are not necessarily all problems. For example, most metals listed have been found only rarely at levels above criteria necessary to protect aquatic life. Furthermore, these criteria were taken from the literature, not studies of project conditions and resident aquatic life. Only at Union Village Dam, Vermont, is there evidence of metals adversely affecting aquatic life, and the effects appear minor. Metals at Union Village Dam originate in acid mine drainage from abandoned copper mines upstream from Corps project boundaries. At the remaining NAE projects, metals appear to be the result of upstream wastewater discharges, or natural watershed conditions and effects of acid rain. Mercury is a concern at all NAE projects; however, mercury contamination of fish is a problem for all New England States, and large sections of the rest of the country. The widespread nature of the mercury problem is due to atmospheric deposition. Most color, iron, manganese, and some low pH levels originate in swamps and marshes in the watersheds. Acid rain is suspected of being responsible for very low pH levels. High nutrient levels originate primarily in agricultural runoff and wastewater treatment plant discharges. Erosion in watersheds, and algal blooms in reservoirs, are sources of high turbidity at NAE projects. Urban runoff, wastewater treatment plant discharges, and agricultural runoff produce high coliform bacteria counts. Low DO levels are due to natural watershed conditions and excessive algae and aquatic macrophyte growth.

l. Coordination with Other Agencies. NAE tries to coordinate its water quality program with the states and other interests; most of this coordination occurs through informal contacts. Available NAE water quality data on file is made available to all who request it. Results of drinking water analyses are sent to the appropriate State agency within 24 hours. Beach analyses at New Hampshire projects are

TABLE 6

NAE RESERVOIR WATER QUALITY CONCERNS FY00

Project	Low pH	High pH	Low DO	High P	High N	High Color	High Turbidity	High Bacteria	High Metals	Other Concerns	Suspected Contributing Sources
Birch Hill, MA	X		X					X	Hg,Al	PCBs	WWTP discharges, Acid rain
Buffumville, MA	X	X	X	X						Aquatic weeds	WWTP discharges, Acid rain
East Brimfield, MA	X	X	X	X						Aquatic weeds	Swamps & marshes, Acid rain
Hop Brook, CT	X	X	X	X	X	X	X	X	Al,Hg	Algae blooms	Urban runoff, Farm runoff, Acid rain
Hopkinton, NH	X		X							Algae, snails	WWTP discharges, Acid rain
Northfield Brk, CT	X			X	X			X	Hg	Algae blooms	Acid rain
North Hartland, VT		X		X	X		X		Hg,Al		WWTP discharges
Thomaston, CT									Hg, Pb, Al		WWTP discharges, Acid rain, Urban runoff
Tully, MA	X		X			X			Hg	Tannic acids	Swamps and marshes
Union Village, VT							X	X	Hg,Cd,Cu, Zn,Al,Fe	Acid mine drainage	Abandoned copper mines, Farm runoff
West Thompson, CT	X	X	X	X	X	X	X	X	Hg,Al, Pb	Algae blooms,	WWTP discharges, Acid rain

sent to the New Hampshire Department of Environmental Services monthly. Water quality monitor data from the Town Brook tunnel is sent to Massachusetts monthly. Copies of the Annual Water Quality Report are sent to State agencies in all six New England States, the U.S. EPA, and interested private organizations.

m. Continuing Water Quality Problems. There are five reservoir projects, operated and maintained by NAE, that have continuing water quality problems: Hop Brook, Northfield Brook, and West Thompson Lakes in Connecticut, Birch Hill Dam in Massachusetts, and Union Village Dam in Vermont. This section summarizes the problems, and how NAE is addressing them.

(1) Hop Brook Lake. This project has chronic high bacteria counts and algae blooms, causing the popular beach to be closed to swimming often. These problems originate in land-use practices outside the borders of Hop Brook Lake. Consequently, NAE has tried to involve State and local agencies in taking actions such as checking for failing septic systems, and helping farmers use good agricultural practices. Additionally, NAE is designing sedimentation basins on tributary streams to intercept suspended sediment containing the phosphorus that fuels algae blooms. Finally, because lake bacteria counts tend to rise after heavy rains, the relationship between runoff and bacteria levels has been studied, and protocols developed to maximize the amount of time the lake can safely be open.

(2) Northfield Brook Lake. Bacteria counts at the popular beach at this small project tend to rise and fall quickly when it rains. Consultations with the local health department have indicated that the problem is not due to any particular source, but from the watershed in general, which is small, hilly, and generates runoff quickly when it rains. After studying the relationship between rainfall and beach bacteria counts, NAE developed and tested a beach closure protocol based on rainfall. NAE also adopted a new test for *Enterococci* that gives results within 24 hours, as a replacement for the standard test that takes 48.

(3) West Thompson Lake. This lake has severe annual algae blooms which look nasty and disrupt its ecosystem. NAE is continuing to gather data on sources of the excess phosphorus fueling these blooms.

(4) Birch Hill Dam. Sediments at this project are contaminated with PCBs. NAE is involved in a multi-year study of this problem. Findings are being fully coordinated with Massachusetts and other interested agencies and private parties. Massachusetts and the US EPA are attempting to identify PRP's; if any are identified, it will affect the future course of the studies.

(5) Union Village Dam. Acid mine drainage from abandoned copper mines interferes with benthic habitat and colors the river red during high runoff events. As the mines are not on Corps property, NAE has no control over them, but when possible through programs of technical assistance to the States, NAE has studied the mine drainage problems and outlined methods to stabilize the tailings piles which cause most of the problems. However, due to the complexity of the site and the potentially hazardous and toxic materials involved, EPA is considering dealing with the site under the Superfund program.

n. FY01 Reservoir WQ Management Activities. NAE's FY01 Reservoir Water Quality Management Program will be determined by the Water Quality Team in mid-winter, based on an analysis of data collected in FY00. The anticipated FY01 program will cost an estimated $246,000 and cover a range of studies. Work items will likely include (1) baseline fixed station monitoring at class II and I projects with conservation pools and class III projects without permanent pools, (2) EPA priority pollutant scans at one or more projects, (3) continuation of the bathing beach and potable water quality monitoring, (4) continued investigation of the relationship between rainfall and bacteria levels at beaches, to develop better means of determining when to close and reopen swimming areas, and (5) carrying out Operation Lakewatch at one or more projects.

4. OTHER WATER QUALITY STUDIES, INVESTIGATIONS, AND DESIGNS PERFORMED IN FY00

a. Knightville Dam Fish Passage. As part of restoring historic Atlantic salmon runs, NAE is studying fish passage at Knightville Dam. Restoration efforts on the Westfield River have had very promising results, but returning adults currently have to be transported around the Knightville Dam structure. Although no pool is maintained at the project as a barrier to migration, the slope of the discharge conduit is too great to allow sufficient depth of flow for upstream passage during normal conditions. Downstream passage is not a problem. The remedy the Corps is considering for upstream passage is to construct an inflatable barrier downstream of the outlet works. This barrier would create a pool with a backwater extending into the conduit to allow fish to swim through it. A fish ladder would enable fish to get past the inflatable barrier. The barrier would be deflated so as not to interfere with flood control releases, when flows would be too great for upstream passage anyway. As part of the studies for this project, NAE installed an automatic water quality monitor (AWQM) at the Knightville discharge during the summer of FY00. The purpose of this AWQM was to confirm that water quality in the river was good and a pool created below the outlet would have conditions favorable for salmon passage or resting. Results have shown that water quality in this pool should not be a

problem.

b. Town Brook Tunnel Water Quality. The Water Quality Certificate issued by the Massachusetts DEP for the Town Brook tunnel requires water quality sampling and monthly reporting of results. The 4,000 foot long, deep rock tunnel is a key part of the Town Brook Local Protection Project, and it has sophisticated water quality controls built into it. It is a relief tunnel and only receives major inflows during storm events. Between storms, seawater can enter the tunnel through the outlet twice a day during high tides. The resulting mix of urban storm runoff with saltwater in an enclosed tunnel with minimal flushing (between storms) could easily lead to anaerobic conditions and the generation of hydrogen sulfide. To prevent this, the tunnel has a system of flushing pipes connected by pumps to cascade aerators at the tunnel entrance and exit. In addition, air compressors are connected to diffusers to supply additional dissolved oxygen (DO) in an emergency. AWQM's measuring DO, pH, temperature, and conductivity are connected to these pumps. Every day at a little past midnight, the pumps come on to send water to the AWQM. If the DO is above 6.0 ppm, the system shuts down; however, if it is less than that, the pumps continue to run water over the aeration cascades for an hour when another reading is taken. This reading must be at least 6.5 ppm; otherwise, pumping and aeration continue with hourly checks until 6.5 ppm is achieved. This system can be remotely accessed by computer, and data can be retrieved or the system turned on or off at any time. Each month the previous month's data are retrieved and sent to the DEP.

Data from the tunnel's AWQM showed generally good to excellent DO conditions during FY00. Except for an unusually cold period in January when a line froze and monitor gave meaningless results, there were only 6 days in FY00 when a DO below 6.0 was recorded, only one day when a DO below 5.0 was reported, and the minimum recorded was 4.91 ppm.

There are monitors at the tunnel's inflow and exit shafts, but only the inflow monitor has been usable because of problems with the recirculation pumps at the outlet shaft. In September 2000 those problems were corrected and the outlet monitor began supplying useful data. Comparison of the inlet and outlet monitors shows good agreement. Because of the arrangement of the recirculation pumps, the outlet monitor receives a high proportion of fresh water than the inlet monitor does, and this results in differences in conductivity and temperature readings.

NAE will continue sending AWQM data to the DEP until the tunnel is turned over to the MDC. However, even after the transfer occurs, NAE will use the com-

puter connection to keep an eye on water quality conditions.

c. Town Brook Smelt Spawning. Due to concerns about the Town Brook local protection project's potential to affect flows in smelt-spawning areas of Town Brook, a smelt conservation team was formed in 1998. This team had members from the Corps, City of Quincy, MDC, Massachusetts Division of Marine Fisheries, and U.S. National Marine Fisheries Service. In FY00, NAE reconstructed part of the Centre Street junction structure, a portion of the nonfederally-constructed local protection project, to improve its reliability in providing sufficient flow for spawning.

d. Parker Pond. Parker Pond in north central Massachusetts is heavily filled in with sediment and suffers from severe aquatic weed problems, especially the nonnative weed fanwort. The combination has greatly restricts habitat for aquatic animals, especially fish. Under authority in section 206 of the 1999 Water Resources Development Act, NAE is planning means to improve the pond. Results based on past studies and water quality and fish sampling by the Corps indicate that selective dredging to deepen the pond and remove aquatic plants and nutrient-laden sediments will improve the lake's biodiversity including the return of several fish species. The draft report on water quality improvements expected from dredging was completed in FY00.

e. Muddy River Study. The Muddy River, a minor tributary to the Charles River, is located within a series of Boston area parks referred to as the "Emerald Necklace," designed by the 19th century's most famous landscape architect, Frederick Law Olmsted. Although it begins in the clean, spring-fed waters of Jamaica Pond, water quality along most of its length is very poor due to uncontrolled urban drainage and cross connections to sanitary sewers. In addition, the small drainage area, minimal channel slope, and presence of a series of small ponds, minimize flushing. These conditions have resulted in the buildup of large areas of septic sediments, which further degrade water quality.

The City of Boston, in association with the Town of Brookline and public interest groups, created a master plan for an extensive rehabilitation of the Emerald Necklace parklands in January 1999. This plan includes rehabilitation of bridges, restoration of historic structures, and landscape and traffic improvements. As a first phase, the plan proposes to improve water quality and aquatic habitat, and reduce flooding through a bank-to-bank sediment-dredging project.

NAE is currently conducting feasibility level studies to determine the level of Corps involvement. WMS contracted with the firm of Camp, Dresser and McKee, Inc. (CDM) for technical analyses related to this review.

f. Sagamore Salt Marsh Restoration. Construction of the Cape Cod Canal in the 1930's caused significant degradation of the Sagamore salt marsh, when excavated material placed in the marsh changed the direction of wetland drainage and restricted saltwater exchange. Before the canal, the Scusset River drained the marsh into Cape Cod Bay, but dredged material disposed of in the marsh directed the river away from the Marsh and limited tidal flows to what could pass through two 48-inch culverts. Reduced tidal inflows changed the nature of the marsh from a saltwater to a mostly freshwater environment. Under authority in the Water Resources Development Act of 1986, the Corps began investigations of means to restore the salt marsh without flooding homes or yards, or impacting water supply wells around the marsh. Computer modeling by WMS was an essential part of this restoration plan. The construction phase of the salt marsh restoration began in FY00, when NAE began monitoring pre-project conditions and developing a plan for monitoring post restoration conditions.

g. Rhode Island Salt Pond Restoration. In FY98 NAE completed a reconnaissance study to restore eelgrass in certain salt ponds along the Rhode Island coast. Siltation and channel restrictions have reduced tidal inflows, and this has reduced the extent of eelgrass beds, which are important nursery areas for many species. Selective dredging would increase saltwater inflows. In FY99, NAE began the feasibility study, and in FY00 WMS modeled sediment transport. Environmental restoration studies of the ponds are nearing completion.

h. Turner Reservoir. At the request of the City of East Providence, Rhode Island, the Corps began preliminary investigations of the feasibility of using Turner Reservoir for public water supply or more intensive recreation. The water's appearance is not attractive, with large amounts of aquatic weeds and numbers of waterfowl. However, Corps investigations, including water quality and fish sampling, did not find any water quality problems that would prohibit using Turner Reservoir for recreation including swimming, or for public water supply. The draft report on water quality was completed in FY00.

i. Yarmouth Salt Marsh Restoration. In FY00, WMS initiated work on a feasibility study to restore the ecology and health of Run Pond, a coastal salt pond with surrounding salt marsh in Yarmouth, Massachusetts. Over twenty years ago when the town constructed a boat ramp and parking lot, they replaced the existing channel with a 900-ft long, 36-inch diameter culvert. This culvert has significantly less capacity than the old channel and restricts tidal flushing of the pond, which experiences extensive algal blooms each summer. WMS performed numerical modeling of tidal flow into and out of the salt marsh in FY00, evaluating various

culvert alternatives to improve tidal flushing. The current schedule calls for completion of the feasibility report in FY01, plans and specifications in FY02, and construction in FY02 and FY03.

j. Providence River Dredging Studies. WMS is studying disposal locations for dredged material from the Providence River in Rhode Island. This involves the use of complex computer programs to model sediment movement, and physical studies of sediment characteristics. The effects on water column concentrations of sediment and copper were analyzed using the Single dump Fate (STFATE) model, which was also used to simulate the expected footprint and sediment layer thickness. The SURGE model was used to estimate the bottom energy from a single confined aquatic disposal (CAD) cell disposal simulated using the STFATE model. Energy dissipation was used to predict the amount of sediment that will move outside the CAD cell walls. The LTFATE model was used to make long-term erosion predictions for the site. Studies are mostly finished, and are being incorporated into a final EIS, which should be published in 2001.

k. Superfund Site Studies. Water quality concerns are a major part of Superfund projects. Contaminated soil and groundwater are the most commonly encountered problems. Because of ground water mobility, water quality can be both the most important and complicated aspect of cleanups. In FY00 WMS was involved in long term monitoring studies at Baird and McGuire and cleanup of the continuing source areas at the Nyanza Chemical Company sites in Massachusetts. WMS was also involved in groundwater sampling as part of long-term monitoring of the cleanup of former military sites in Massachusetts and Rhode Island.

5. TRAINING AND ATTENDANCE AT WATER QUALITY MEETINGS AND CONFERENCES

In November, WMS members attended annual hazardous waste operations and emergency response refresher training.

6. WATER QUALITY RESEARCH/GUIDANCE NEEDS

Listed below are areas where NAE's water quality programs and studies could benefit from research or guidance from Corps Labs or OCE.

- Guidance in conducting studies of the relationship between rainfall and beach bacteria levels would be very useful. Although the final result will be uniquely project specific, methods for conducting these studies would likely be broadly applicable.

- Environmental studies at NAE will increasingly require use of sophisticated PC-based water quality models such as CEQUAL.ICM. Training and technical assistance will be required in the use of these models. It is important that these models are made as user-friendly as possible.

- The LTFATE model developed by WES to determine the long term fate of contaminants in dredged material is an example of an important program that needs improvement. The "user friendly" version was found to have relatively few options for handling output. Changes to allow control of printout and manipulation of files would be extremely useful.

7. USE OF CORPS LABS IN FY00

NAE did not contract work to Corps Labs in FY00.

8. USE OF CONTRACT LABS IN FY00

As described in paragraph 3b, NAE uses contract labs to perform all analyses for its water quality program. In addition, NAE contracted with Battelle to collect and analyze sediment samples for the Baird & McGuire long-term monitoring.

9. DISTRIBUTION LIST

a. Corps of Engineers

North Atlantic Division
District Engineer
Chief, Engineering/Planning Division
Chief, Construction/Operations Division
Chief, Public Affairs Office
Upper Connecticut River Basin Manager
Lower Connecticut River Basin Manager
Thames River Basin Manager
Naugatuck River Basin Manager
Merrimack River Basin Manager
Chief, Geotechnical and Water Management Branch
Chief, Operations Technical Services Branch
Chief, Evaluation Branch
Mr. Hubbard
Mr. Williams
Mr. Trinchero
Mr. Barker
Mr. Levitt
Mr. Hays

b. Non-Corps

Secretary
Executive Office of Environmental Affairs
Saltonstall Building
100 Cambridge St
Boston, MA 02202

Mr. Jeffrey H. Taylor, Director
Office of State Planning
2-1/2 Beacon Street
Concord, NH 03301-4497

Mr. John Kassel, Secretary
Agency of Natural Resources
103 South Main Street
Waterbury, VT 05676

b. Non-Corps (cont.)

Mr. Eban D. Richert, Director
State Planning Office
State House Station #38
184 State Street
Augusta, ME 04333-0001

Mr. Andrew McCloud, Acting Director
Department of Environmental Management
235 Promenade Street
Providence, RI 02908

Mr. Arthur J. Rocque, Jr., Commissioner
Department of Environmental Protection
79 Elm Street
Hartford, Connecticut 06106

Director
Water Management Branch
U.S. Environmental Protection Agency
J.F. Kennedy Federal Building
Boston, Massachusetts 02203

Mr. Thomas Willard
Vermont Agency of Natural Resources
Department of Environmental Conservation
Montpelier, Vermont 05602

Mr. Russell Isaac
Massachusetts Division of Water Pollution Control
One Winter Street,
Boston, Massachusetts 02108

Director and Chief Engineer
Massachusetts Division of Water Resources
Leverett Saltonstall Building
100 Cambridge Street
Boston, MA 02202-0001

b. Non-Corps (cont.)

Chairman
New Hampshire Department of Environmental Services
Water Resources Division
64 North Main Street
Concord, NH 03301-4913

Commissioner
Department of Environmental Protection
State Office Building
Hartford, CT 06106

Mr. Karl L. Jurenthuff
Department of Environmental Conservation
Building 10N
103 South Main Street
Waterbury, VT 05671-0408

Director
State of New Hampshire Fish and Game Department
2 Hazen Drive
Concord, NH 03301-6507

Ms. Nancy Brown
Connecticut River Watershed Council, Inc.
One Ferry Street
Easthampton, MA 01027

APPENDIX A

EXPLANATION OF NAE RESERVOIR PROJECT WATER QUALITY CLASSIFICATION SYSTEM

EXPLANATION OF NAE RESERVOIR PROJECT WATER QUALITY CLASSIFICATION SYSTEM

The 31 projects maintained and operated by NAE are grouped into three categories, based on past and present water quality conditions. Five factors are used in the assignment of classes: (1) statements of project conditions in past NAE Annual Water Quality Reports, (2) State Water Quality Reports, including information on upstream watershed activity, (3) identifiable changes between inflow and discharge water quality, (4) frequency of violation of water quality criteria, and (5) existence of a conservation pool.

Simply stated, class I projects have high water quality, class II projects have minor or suspected water quality problems, and class III projects experience continuing water quality problems. Low level, fixed station monitoring is applied at class I and class II projects, and high level monitoring is applied at class III projects. Class III projects have the highest priority for intensive surveys or other special studies, and class II projects have a low priority. No intensive surveys are planned for class I projects.

APPENDIX B

STATE WATER QUALITY CLASSIFICATIONS
NAE PROJECTS

STATE WATER QUALITY CLASSIFICATIONS OF NAE RESERVOIR PROJECTS

Project	State	Classification
Ball Mountain Lake	VT	B
Barre Falls Dam	MA	A
Birch Hill Dam	MA	B
Black Rock Lake	CT	B
Blackwater Dam	NH	B
Buffumville Lake	MA	B
Colebrook River Lake*	MA	A
Colebrook River Lake	CT	AA
Conant Brook Dam	MA	A
East Brimfield Lake	MA	B
Edward MacDowell Lake	NH	B
Everett Lake	NH	B
Franklin Falls Dam	NH	B
Hancock Brook Lake	CT	B
Hodges Village Dam	MA	B
Hop Brook Lake	CT	B
Hopkinton Lake	NH	B
Knightville Dam	MA	B
Littleville Lake	MA	A
Mansfield Hollow Lake	CT	AA
Northfield Brook Lake	CT	B
North Hartland Lake	VT	B
North Springfield Lake	VT	B
Otter Brook Lake	NH	B
Surry Mountain Lake	NH	B
Thomaston Dam	CT	B
Lead Mine Brook	CT	A
Townshend Lake	VT	B
Tully Lake	MA	B
Union Village Dam	VT	B
West Hill Dam	MA	B
West Thompson Lake	CT	C/B
Westville Lake	MA	B

*Colebrook straddles the Massachusetts/Connecticut border.

APPENDIX C

RESERVOIR WATER QUALITY CONTROL MANAGEMENT REPORTS
NEW ENGLAND DISTRICT

Reservoir Water Quality Control Management Reports
New England Division
(Prepared through FY00)

Project	Report and Date
Connecticut.	
Black Rock Lake	Black Rock Lake Water Quality Evaluation, June 1983. Black Rock Lake Priority Pollutant Scan, March 2000
Colebrook River Lake	Colebrook River Lake Water Quality Evaluation, June 1983. Colebrook River Lake Dissolved Gas Supersaturation Study, August 1984. Colebrook River Lake Priority Pollutant Scan, September 1997.
Hancock Brook Lake	Hancock Brook Lake Water Quality Evaluation, June 1983. Hancock Brook Lake comprehensive Fisheries and Water Quality Investigation (1991 - 1992), Plymouth, Connecticut. Hancock Brook Lake Priority Pollutant Scan, March 2000.
Hop Brook Lake	Hop Brook Lake Water Quality Evaluation, April 1983. Hop Brook Lake Water Quality Evaluation Update, August 1984. Hop Brook Lake Nutrient Balance Study, August 1987. Hop Brook Lake Fisheries Assessment, April 1987. Hop Brook Lake Destratification Study, August 1985. Hop Brook Lake Summary of Limited Biological Survey, May 1981. Hop Brook Lake Close Interval Sampling, Sediment and Algal Progression Study, May 1990. Hop Brook Lake Water Quality Study (Interim Report), June 1990. Hop Brook Lake Water Quality Study (Interim Report), April 1993. Hop Brook Lake, Connecticut, Priority Pollutant Scan, August 1993.
Mansfield Hollow Lake	Mansfield Hollow Lake Water Quality Evaluation, June 1983. Mansfield Hollow Lake Water Quality Evaluation, July 1988. Mansfield Hollow Lake Priority Pollutant Scan, September 2000.
Northfield Brook Lake	Northfield Brook Lake Water Quality Evaluation, January 1983. Priority Pollutant Scan of an Unnamed Brook at Northfield Brook Lake July 1992
Thomaston Dam	Thomaston Dam Water Quality Evaluation, April 1983. Brown Trout Habitat Suitability at Thomaston Dam, Connecticut, February 1987. Limnological Survey at Thomaston Dam, Connecticut, March 1987. Thomaston Dam, Water Quality Evaluation, June 1991. Thomaston Dam, Connecticut, Priority Pollutant Scan, August 1994.

Connecticut. (cont.)

West Thompson Lake	A Biological and Chemical Survey of Algal Blooms at West Thompson Lake, Connecticut, August 1979. West Thompson Lake Water Quality Evaluation, April 1983. West Thompson Lake Water Quality Evaluation Update, June 1984. Final Report on the West Thompson Lake Algae Control Study, June 1986. West Thompson Lake Algal Progression Study, June-July 1988; Jan. 1989. West Thompson Lake Algal Progression Study, June-Sept. 1992; Feb. 1995. West Thompson Lake, Connecticut, Priority Pollutant Scan, December 1994.

Massachusetts.

Barre Falls Dam	Barre Falls Dam Water Quality Evaluation, June 1983. Barre Falls Dam, Massachusetts, Priority Pollutant Scan, January 1995.
Birch Hill Dam	Birch Hill Dam Water Quality Evaluation, April 1983. Birch Hill Dam Water Quality Evaluation, July 1987. Birch Hill Dam, Priority Pollutant Scan, Interim Report, July 1988. Birch Hill Reservoir PCB Investigation, July 1989. Birch Hill Reservoir PCB Investigation, September 1990. Birch Hill Reservoir PCB Investigation, Phase I, October 1991. Birch Hill Reservoir PCB Study, March 1992
Buffumville Lake	Buffumville Lake Water Quality Evaluation, January 1983. Buffumville Lake Water Quality Evaluation Update, May 1984. Buffumville Lake Water Quality Evaluation, August 1985. General Limnological Survey, Buffumville Lake, 1985.
Charles River NVSP	Charles River NVSP Water Quality Assessment, June 1987.
Conant Brook Dam	Conant Brook Dam Water Quality Evaluation, June 1983. Conant Brook Dam Priority Pollutant Scan, April 2000.
East Brimfield Lake	General Limnological Survey, The East Brimfield Project/Lake. 1982. East Brimfield Lake Water Quality Evaluation, January 1983. East Brimfield Lake Water Quality Evaluation Update, September 1984. East Brimfield Lake - Iron, July, 1996.
Hodges Village Dam	Hodges Village Dam Water Quality Evaluation, April 1983.
Knightville Dam	Knightville Dam Water Quality Evaluation, June 1983. Knightville Dam Fishery Assessment, Huntington, Massachusetts, May 1989
Littleville Lake	Littleville Lake Water Quality Evaluation, January 1983. Fisheries Assessment, Littleville Lake, 1987.
Tully Lake	Tully Lake Water Quality Evaluation, June 1983. Tully Lake Evaluation of Effects of Flood Control Project Operations on Water Quality, September 1984. Tully Lake Fisheries Investigation (June-August 1993)

Massachusetts. (cont.)

West Hill Dam	West Hill Dam Water Quality Evaluation, April 1983. West Hill Dam Priority Pollutant Scan, April 1999
Westville Lake	Westville Lake Water Quality Evaluation, January 1983.

French River Projects Priority Pollutant Scan, January 1999

New Hampshire.

Blackwater Dam	Blackwater Dam Water Quality Evaluation, June 1983.
Edw. MacDowell Lake	Edw. MacDowell Dam Water Quality Evaluation, January 1983.
Everett Lake	Everett Lake Water Quality Evaluation, September 1982. Everett Lake Water Quality Evaluation, January 1983.
Franklin Falls Dam	Franklin Falls Dam Water Quality Evaluation, April 1983. Franklin Falls Dam Water Quality Evaluation, April 1984. General Limnological Survey, Franklin Falls Dam, 1984.
Hopkinton Lake	Hopkinton Lake Water Quality Evaluation, September 1982. Hopkinton Lake Water Quality Evaluation, April 1983. Elm Brook Pool Water Quality Evaluation, September 1982. Hopkinton Lake, Priority Pollutant Scan, June 1988. Hopkinton Lake, An Assessment of the Fishery, November 1995.
Otter Brook Lake	Otter Brook Lake Water Quality Evaluation, April 1983. Otter Brook Lake Evaluation of Effects of Flood Control Project Operations on Water Quality, May 1984. Otter Brook Lake, New Hampshire Fisheries Assessment, November 1987. Otter Brook Lake, New Hampshire, Priority Pollutant Scan, February 1993.
Surry Mountain Lake	Surry Mountain Lake Water Quality Evaluation, June 1983. Surry Mountain Lake, New Hampshire Fisheries Assessment, Nov. 1987.

Vermont.

Ball Mountain Lake	Ball Mountain Lake Water Quality Evaluation, August 1982. Ball Mountain Lake Water Quality Evaluation, June 1983. Ball Mountain Lake Water Quality Evaluation, September 1987.
North Hartland Lake	North Hartland Lake Water Quality Evaluation, August 1982. North Hartland Lake Water Quality Evaluation, January 1983. North Hartland Lake Water Quality Evaluation, September 1986. Smallmouth and Largemouth Bass Suitability at North Hartland Lake, Vermont, November 1987.

Vermont (cont.)

No. Springfield Lake	North Springfield Lake Water Quality Evaluation, August 1982. North Springfield Lake Water Quality Evaluation, April 1983. Stoughton Pond at North Springfield Reservoir Water Quality Evaluation, August 1982. North Springfield Lake Fishery Assessment, North Springfield and Weathersfield, Vermont, May 1989. North Springfield Lake Fisheries Investigation, and Status of Largemouth Bass Fishery in 1991, North Springfield and Weathersfield, Vermont, May 1996.
Townshend Lake	Townshend Lake Water Quality Evaluation, September 1982. Townshend Lake Water Quality Evaluation, June 1983. Atlantic Salmon Suitability at Townshend, Vermont, November 1987.
Union Village Dam	The Effects of Mine Drainage at the Union Village Project, (A Preliminary Biological and Chemical Survey), March 1980. Union Village Dam Water Quality Evaluation, January 1983. Union Village Dam Water Quality Evaluation Update, August 1984. Union Village Dam Water Quality Evaluation, September 1989.

Vermont Lakes Priority Pollutant Scan, June 1998